U. S. FOREST SERVICE

RESEARCH NOTE LS-47

KE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Comparing Severity of Fire Seasons

An unusually bad or exceptionally easy fire season always stimulates interest in just *how* bad or easy the season was. For instance, how much do we remember about previous bad fire years? Frequently one large fire may create a false and lasting impression of an exceptionally bad fire season, or a small number of fires may be falsely interpreted as an easy fire season. Do we recall only the years when rainfall was below normal and the temperature was above average, or are our most vivid memories of the years with a high fire incidence and large area burned?

In comparing fire seasons, the number of fires and area burned, when considered alone, do not always indicate the severity of burning conditions. The best means of accurately comparing the burning conditions for 2 or more years is to use an accumulative daily fire weather index computed from basic weather data collected at representative weather stations. This index, described below, can then be used to compare individual years.

Rating Fire Danger

Rating forest fire danger involves more than just recording daily weather data. Figures pertaining to both cumulative and current weather variables are needed to permit a better understanding of fire potential.

There has been a need for an index that could be computed from daily weather records and that could indicate a buildup or decrease in fire weather severity. Such an index has been provided through the recent development of the first phase of a Unified National System of Fire Danger Rating. This first phase has been tested at selected weather stations and is now ready for operational use. Included in the first phase is a Buildup Index, which is an indicator of progressive drying conditions in intermediate-size forest fuels (2- to 3-inch litter layer or 3-inch-diameter dead branchwood), and a Fire Spread Index, in which the Buildup Index, wind, and relative humidity are used to rate current fire weather in much the same way as the Lake States Burning Index meter has been used at Lake States fire-weather stations. Research is underway on the associated factors of risk, ignition, and fire intensity; these variables may eventually be integrated to provide the total fire danger rating picture. The Lake States Burning Index, based on a 100-point scale, rates day-to-day burning conditions and is influenced by current wind, humidity, and precipitation. The Buildup Index is mainly concerned with moisture content of forest fuels as influenced by air temperature, air moisture, and precipitation; wind is not considered.

The Buildup Index has an "open-end" numerical scale which increases as fuel moisture decreases and drying conditions become more critical. With an increasing Buildup Index, an increasing amount of fuel becomes dry enough to burn and fires are more difficult to control. Buildup Index values in excess of 150 will probably rarely occur in the Lake States. However, in the more arid sections of the West, values of 200 to 300 would not be uncommon.

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Using the Buildup Index

The Buildup Index is essentially a "fire warning system." It is used for alerting fire control agencies of changes in fuel moisture and burning conditions. When plotted daily, it gives a realistic picture of the *potential* for large, damaging fires. A high Buildup Index does not mean that all fires that occur during these periods will become large — it does indicate that fires that do occur are likely to be more difficult to control than those occurring in the lower *range* of Buildup Index.

Comparison of 1936 and 1961 Fire Seasons in Northern Minnesota

The following example illustrates how the Buildup Index can be used, together with other weather variables, as a basis for comparing two fire seasons. Fire control agencies are encouraged to utilize this simple method of fire weather analysis to help them better understand, from a weather standpoint, some of the differences between fire seasons.

We know that the 1961 spring and early summer fire season in northern Minnesota was unusually severe; but to determine just *how* severe, we needed data on at least one more bad fire year. The 1936 fire season, remembered by many as one of the most severe in history, was chosen. In 1936 high temperatures and subnormal rainfall created a moisture deficit in the forest fuels that lasted into late summer and early fall. Altogether, 302,580 acres of State and National Forest timberland burned.

Six northern Minnesota weather stations were chosen as being representative of the area. These were Cass Lake, Littlefork, Waskish, Ely, Baudette, and Cut-Foot Sioux Ranger Station. The 1961 weather records for these stations were available locally, and the 1936 weather records were obtained from the U.S. Weather Bureau's National Weather Records Center in Asheville, N.C. Annual State weather summaries, published by the U.S. Weather Bureau, were also used in the analysis.

The maximum Buildup Index for the six stations during May, June, July, and August 1936 and 1961 is summarized in table 1. In general, June and July 1961 were more critical from a fire-weather standpoint than the same months in 1936, but in August the 1936 weather was generally more severe. The following quotes, taken from the U.S. Weather Bureau's Climatological Data for August 1936, reflect the seriousness of the situation: "Unusually dry weather prevailed during the first two weeks . . . record-breaking high temperatures occurred on August 15 . . . high temperatures during the first half of the month caused considerable deterioration to growing crops. Meadows and pastures dried up . . . reports of trees and game and fish dying because of the drought . . . forest fire situation was acute."

TABLE 1. — *Maximum Buildup Index for May, June, July, and August, 1936 and 1961*

Station	May		June		July		August	
	1936	1961	1936	1961	1936	1961	1936	1961
Baudette	61	72	75	84	70	93	67	70
Ely	26	45	54	102	61	142	86	50
Littlefork	51	62	64	112	56	150	61	67
Waskish	39	55	51	87	75	117	83	39
Cut-Foot Sioux—Cass Lake[1]	44	47	37	96	83	96	127	74
Five-station avg.	44	55	52	96	69	120	85	60

[1] *These two stations represent similar conditions of fuels and weather and are combined here for analysis purposes.*

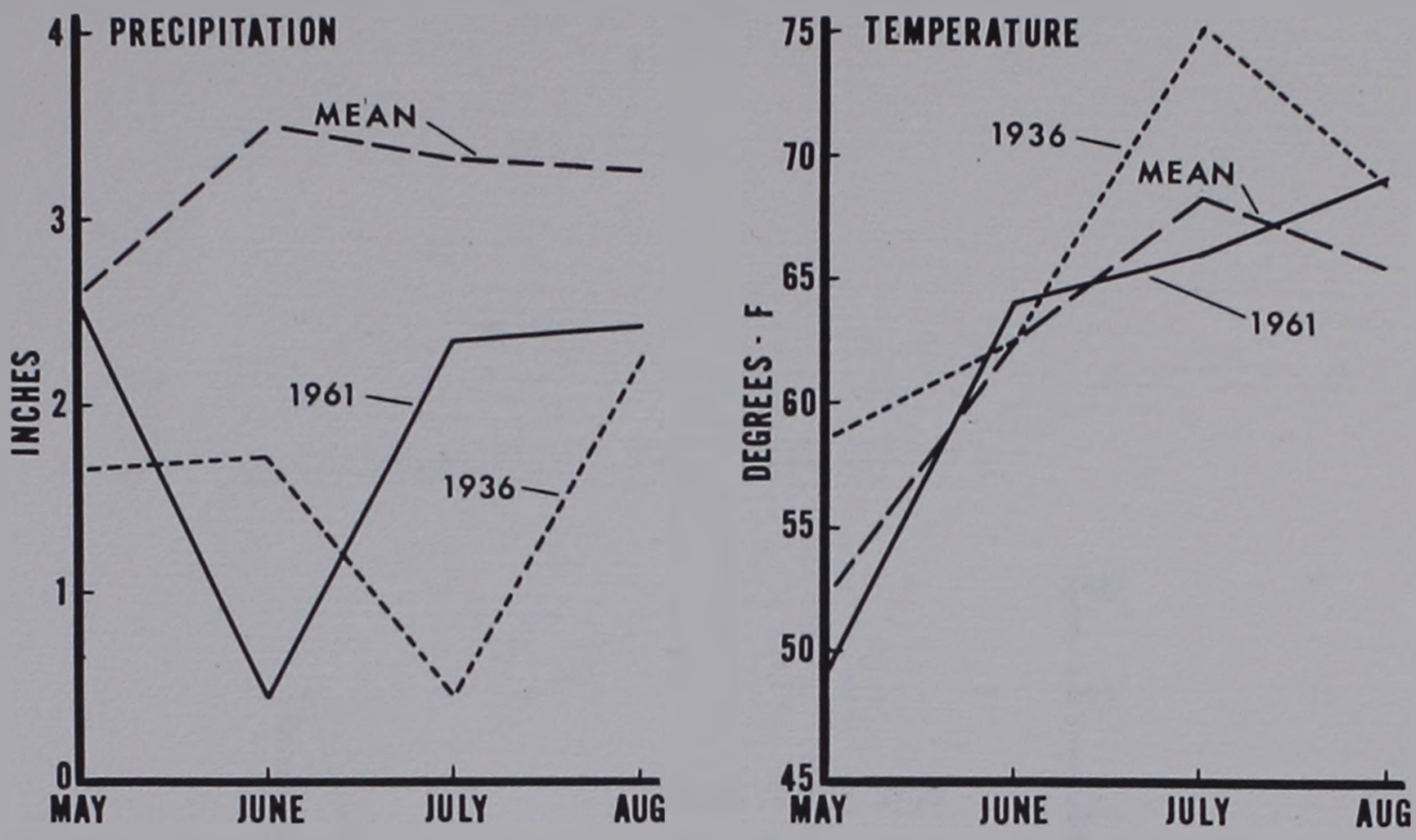

FIGURE 1. —Comparison of precipitation and temperature for 1936 and 1961 with the 29-year means (1921-1950), Bemidji, Minn.

Looking at the individual stations, we find that for June and July 1961 the burning conditions at Ely and Littlefork were much more critical than they were for the same period in 1936. Burning conditions at Baudette in May, June, July, and August were nearly the same for 1936 and 1961.

Figure 1 shows precipitation and temperature in relation to a 29-year mean recorded at Bemidji, Minn. Except for May 1961, precipitation for the spring and summer months was well below the mean for both 1936 and 1961. Extreme precipitation deficiencies were recorded in June 1961 and July 1936. The May and June mean temperatures in 1936 were both well above the established 29-year means. However, the temperatures during the period of high fire danger in June and July 1961 deviated only slightly from the established mean, indicating that severe fire weather can occur without abnormally warm daytime temperatures.

In Figure 2 an average daily Buildup Index for May through August is shown for four primary weather stations: Baudette, Ely, Littlefork, and Waskish. This graph indicates that the 1961 burning conditions in northern Minnesota during May, June, and early July were more severe than for the same period in 1936. However, the 1936 weather for late July and August was more severe than for the same period in 1961.

In general, the 1961 fire season was more severe. Several moderately high peaks of Buildup Index for 1936 indicate the frequent occurrence of rather severe burning conditions. However, the potential for large fires was greater in 1961, at least during late June and early July, when the average Buildup Index for the four stations reached a peak of 122 on July 9.

July 1964

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Research Foresters

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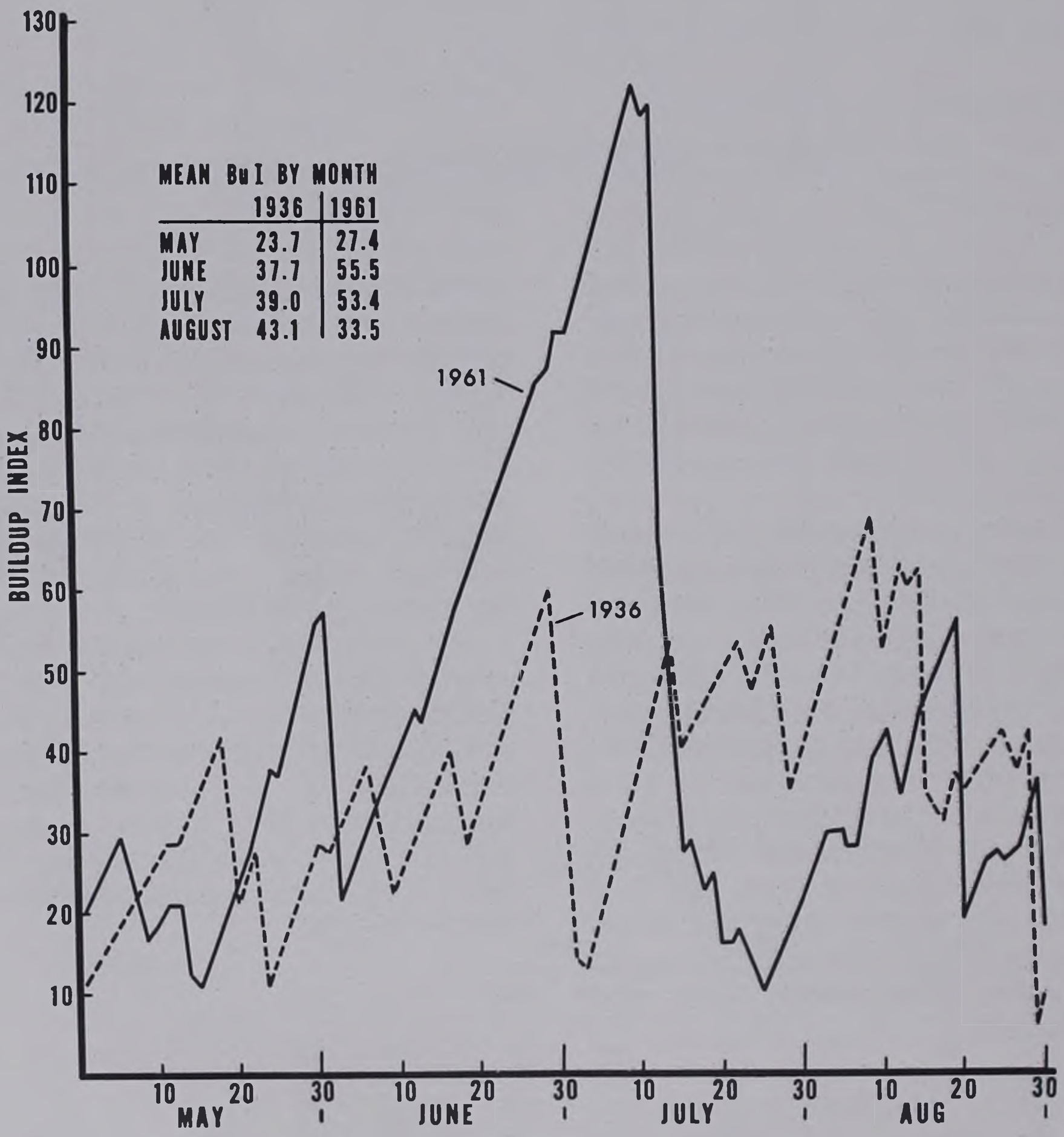

FIGURE 2. — Average Buildup Index for 1936 and 1961; data from four weather stations — Ely, Littlefork, Waskish, and Baudette, Minn.